Wireless Fingerprint Attendance Marking System

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ABSTRACT
The paper is based upon the idea of making the attendance system automated by using the concept of biometric scanning. The attendance marking system is very tedious when it is done manually. This paper aims at trying to make it digital through the use of fingerprint module and then updating the database by transmitting the information through use of Xbee. The database can also be made available online so that any person can access it and come to know about his/her attendance and it can also reduce the work load of authorities by eliminating the need to maintain a register for attendance.

Keywords
Wireless fingerprint attendance system, Arduino, Xbee, R305.

1. INTRODUCTION
The attendance management truly reflects staff attendance, which provides references for competent authorities. Attendance management is one of the most basic and important management link. Currently, the magnetic card attendance system is widely used. This pattern is flexible and practical. But it has some disadvantages like the card is easy to lose and damage. Lot of literature is available of using fingerprint detection for attendance management [1-8]. The fingerprint has a lot of advantages, such as unique, permanent, good anti-fake and easy to use. So it is recognized increasingly by people. The ZigBee technology is an emerging technology developed in recent years. Comparing with some existing wireless communication technologies, the ZigBee has advantages in low-power and low-cost. It is very suitable for application to wireless sensor networks. Aiming at the disadvantages of traditional wire attendance system, a design method of wireless fingerprint attendance system based on ZigBee technology is proposed. It achieves attendance management by fingerprint identification. It realizes low-cost, low-power and high performance fingerprint information acquisition, transmission and recognition function, which provided a new attendance way for enterprises and institutions. In the proposed paper complete development and implementation of the attendance management system is provided. Various modules which constitutes different parts of the attendance management system are explained using their hardware requirement. Also in the end a complete costing of the proposed system is listed.

2. SYSTEM DESCRIPTION

2.1 Fingerprint Module
The fingerprint module as shown in Fig. 1 is used to scan the finger and then it converts it to image and then a character file. There are 256 storage memory spaces in the module.

Fig 1: R305 module

The data that is stored in the module in then given to the controller to be read and recognized/matched in the database.

2.1.1 Operating Principle
Fingerprint processing includes two parts: fingerprint enrolment and fingerprint matching (the matching can be 1:1 or 1: N). While enrolling the user has to place his finger twice on the module. The device generates a template using these images. The template can then be stored in the library. For fingerprint matching, the user again has to place his finger twice. The template generated can then be used for 1:1 matching or 1: N matching. For 1: N matching, the template is compared with all the templates in the library. The system returns the result of success or failure.

2.1.2 System Resources
To address demands of different customer, module system provides abundant resources for the user.

a. Notepad-
The system sets aside a 512-bytes memory (16 pages* 32 bytes) for user's notepad, where data requiring power-off protection can be stored. The host can access the page by instructions of PS_WriteNotepad and PS_Read Notepad.

b. Buffer-
There is an image buffer and two 512-byte-character-file buffer within the RAM space of the module. Users can read & write any of the buffers by instructions.

c. Image buffer-
Image buffer serves for image storage and the image format is 256*288 pixels. When transferring through UART, to quicken speed, only the upper 4 bits of the pixel is transferred (that is 16 grey degrees). And two adjacent pixels of the same row will form a byte before the transferring. When uploaded to PC, the 16-grey-degree image will be extended to 256-grey-degree format. That's 8-bit BMP format. When transferring through USB, the image is 8-bit pixel, that's 256 grey degrees.

d. Character file buffer-
Character file buffer, CharBuffer1, CharBuffer2, can be used to store both character file and template file.

Table 1: Features of R305 Module

Operating Voltage	DC 3.6V-6.0V
Operating Current	Typical:100mA Peak:150mA
Baud Rate	(9600*N)bps, N=1~12(default N=6)
Average Searching time	<0.8s(1:880)
Working Environment	Temp:- 10°C-+40°C
	RH: 40%-85%
Interface	UART(TTL logical level)/USB 1.1
Matching Mode	1:1 and 1:N
Character File size	256 bytes
Template size	512 bytes
Window dimension	18mm*22mm

2.2 Microcontroller

The Arduino Uno as shown in Fig. 2 is a microcontroller board based on the ATmega328. The Arduino is a simple system designed for beginners as well as people with experience. Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects.

Fig2: Arduino Uno

Arduino senses the environment through various sensors, and affects its surroundings by controlling lights, motors, and other actuators. You can tell your Arduino what to do by writing code in the Arduino programming language and using the Arduino development environment. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

2.2.1 Specifications of Arduino Uno

Table 2: Specifications

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage(limits)	6-20V
Digital I/O pins	14(Pin 6 provide PWM output)
Analog Input pins	6
DC Current at I/O pin	40mA
DC Current for 3.3V Pin	50mA
Flash Memory	32KB(ATmega328)of which 0.5KB used by bootloader
SRAM	2KB(ATmega328)
EEPROM	1KB(ATmega328)
Clock Speed	16MHz

2.2.2 Characteristics of Arduino

1. Inexpensive - Arduino boards are much cheaper as compared to other microcontroller platforms.
2. Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

3. Simple programming environment - The Arduino programming environment is easy-to-use and has several features for more experienced programmers.
4. Extensible software- The Arduino software is published as open source tools. Users can create their own libraries.
5. Open source and extensible hardware – The Arduino design is available on their website. Experienced circuit designers can create their own Arduino board and make extensions to the available designs.

2.2.3 Software

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and derives from the IDE for the language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a sketch.

2.2.4 Hardware

a. Input and Output

There are 14 pins on the Uno which can be used as an input or output, using the functions pinMode(), digitalWrite() and digitalRead(). They operating voltage is 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

b. Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a.inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).A Software Serial library allows for serial communication on any of the Uno's digital pins.

2.3 Xbee Transmitter and Receiver

The XBee and XBee-PRO RF Modules as shown in Fig. 3 were engineered to meet IEEE 802.15.4 standards. They are used to create low cost and low power wireless networks. The modules require very little power and provide reliable delivery of data between devices. The modules operate within the ISM 2.4 GHz frequency band.

Fig 3: Xbee Module

XBee Modules are available in two form-factors; Through-Hole and Surface Mount. All XBees (with the exception of the XBee 868LP) are available in the popular 20-pin Through-Hole form-factor. Certain XBee modules are also available in a 37-pad Surface Mount design, which is popular for higher volume applications due to the reduced manufacturing costs of SMT technology.

2.3.1 Pin Description of Xbee Module

The pin description for the Xbee module is as shown in the Fig 4 below.

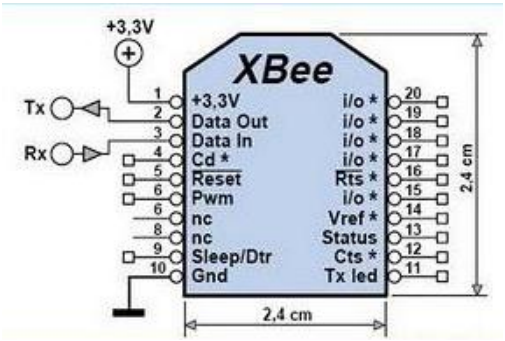

Fig 4: Pin Description of Xbee Module

Xbee uses ZigBee technology. ZigBee is an emerging technology developed in recent years. Comparing with some existing wireless communication technologies, ZigBee has advantages in low-power and low-cost. It is very suitable for application to wireless sensor networks.Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 250 kilobits/second.The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks.

3. WORKING PRINCIPLE

The working of the attendance marking system goes as per the following block diagram shown in Fig. 5.

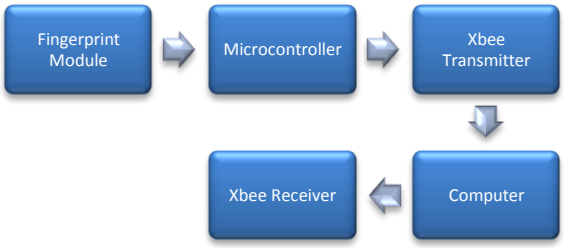

Fig5: Basic block diagram of the system

The basic working principle is as follows:

i. Storing:

- The first part is to store the fingerprints of all the students.
- For this the microcontroller has to first send the command to the fingerprint module to get the image.

- The student is required to place his finger on the module at this time. The module informs the microcontroller whether the image was captured successfully or not.
- If the fingerprint image was captured successfully, it gets stored in the image buffer.
- The microcontroller has to then send the command for generating a character file from the image. This character file is stored in char buffer 1.
- The module informs the microcontroller about the success or failure of the operation. If the operation is successful, the command to get image is sent again.
- The same student has to place the same finger again. The image is again captured and stored in the image buffer.
- Again the microcontroller sends the command to convert the image into a character file. This time, the character file is stored in char buffer 2.
- The microcontroller then sends the command for character file to template conversion to the module. If both the char buffers match, the char file is converted to a template. If they do not match, the operation fails. The module provides this information to the microcontroller.
- This template now needs to be stored at one page ID. For this the microcontroller sends the store image command. These copies the template generated in the char buffer to the given page ID.

ii. Searching:

- For marking the attendance, the finger placed on the module has to be compared with each one stored.
- First the command to get image is sent by the microcontroller.
- The captured image has to be converted to a character file. For this, the image to char command is sent and the character file is stored in char buffer 1.
- The same procedure is repeated and the character file is stored in char buffer 2.
- The two character files are then combined to generate the template using the Regmodel command.
- Now this template in the char buffer has to be compared with each template stored in the module. This is done by sending the search command.
- This returns the page ID at which the match has been found. If no match is found, the module returns the acknowledgement for no match found.
- From the page ID the student who has placed his finger can be identified.

iii. Transmission:

- This page ID now has to be transmitted to the computer.
- Before this, the Xbee modules have to be set up.
- The Xbee network is given a Pan ID, this allows other Xbee boards to identify the network.
- Both the boards have to be given addresses. These are used while communicating.
- The transmitter Xbee transmits the page ID to the receiver Xbee which is connected to the computer.

iv. Database:

- The page ID is read using a terminal software.
- This is given to the database. The page ID is used to identify the student whose attendance is to be marked.
- Thus, the corresponding student is marked as present.

4. COSTING OF PROJECT

Table 3: Cost of Project

Component	Quantity	Cost (Rs.)
Fingerprint Module	1	1600
Arduino Uno	1	1200
Xbee	2	3000
Total	4	5800

5. EXTENSION TO THE PROJECT

- We can interface a GSM module for sending message alerts to the students informing them about the attendance.
- The system can be made fully digital by including a function of sending email at the end of month.
- This project can be added along with feature for calculating salary of employees at the end of the month.
- With the inclusion of GSM module it can also be used widely in wireless alarm of access control system.

6. CONCLUSIONS

This project mainly comprised of development of attendance management system and fingerprint identification system. Attendance management is very helpful in saving valuable time of students and teachers, paper and generating report at required time. This project presented a framework using which attendance management can be made automated and on-line. A general implementable approach to attendance management was proposed using Xbee. Fingerprint Identification System used for student identification is faster in implementation than any other fingerprint identification systems.

7. LIMITATIONS AND FUTURE SCOPE

The range of Xbee is up to 100 feet. So to increase the range repeaters will be required. A website will be hosted on the server for online access to attendance reports. For this purpose, html, JSP or ASP dotnet would be used. This idea can further be elaborated and used for security purposes at various places. As now a days there is a rise in the demand for personal authentication. Biometric authentication is very useful for such applications.

8. ACKNOWLEDGEMENTS

We would like to thank the respected principal Dr. Hari Vasudevan of D. J. Sanghvi College of Engineering for giving us facilities and providing a propitious environment for working in the college. We would also like to thank S.V.K.M. for encouraging us in such co-curricular activities.

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